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UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.MANURE PILES AND FEED LOTS AS SOURCES OF
EUROPEAN CORN BORER REINFESTATIONBy L. B. SCOTT, Assistant Entomologist, Division of Cereal and Forage Insects,
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INTRODUCTION

After the presence of the European corn borer (*Pyrausta nubilalis* Hübn.) in this country became known many suggestions were made as to ways of controlling the insect. As it was apparent that it would be impossible to test all suggested measures immediately, those which seemed to be most important were given first consideration, and therefore immediate attempts were made to determine the possibility of control by the disposal of weed growth and of plant remnants containing corn borer larvae. The disposal of infested material has become one of the largest and most important factors in the plan of control, and the purpose of the investigation discussed in this circular was to find whether corn borer larvae in refuse cornstalks accumulating in manure piles and feed lots survived in sufficient numbers to constitute a serious source of reinfestation.

Investigations have shown conclusively that the ensiling of corn results in a 100 per cent kill of all larvae actually put in silos, and other experiments have indicated that the clean plowing under of infested material can be recommended as a satisfactory control measure. Finely shredding infested stalks kills practically all contained borers, and it is evident that the complete burning of infested material results in the destruction of all infestation. None of these measures, however, includes the treatment of infested material remaining in manure piles and feed lots until after the emergence of the moths of the corn borer.

In the vicinity of Silver Creek, N. Y., it is customary to use rather large quantities of green and dry cornstalks as feed for cattle, the feeding being done in the barns. The leaves and soft portions of

stalks are eaten by cattle, while the coarser sections, containing practically all of the infestation, are usually refused and are ultimately mixed with manure in the barnyard. When stalks are shredded, however, a larger portion of the coarser sections is usually eaten. In the Corn Belt the stalks, instead of being fed in barns, are often placed in feed lots, where animals eat what they want and mix the remaining stalk portions with manure by means of trampling.

It was generally supposed that the unfavorable conditions of temperature and moisture prevailing in manure piles, and the same unfavorable conditions in feed lots, supplemented by the constant trampling of animals, would result in the destruction of most of the borers. Preliminary examinations indicated, however, that a considerable number of larvae could be found in stalks lying on the surface of manure piles and that at least a few individuals survived the unfavorable conditions existing in feed lots.

In order to obtain more definite information on this subject a number of examinations of, and several experiments with, farm manure piles were made at Silver Creek, N. Y., and similar examinations, in addition to observations in feed lots, were conducted at Toledo, Ohio.¹

METHODS OF INVESTIGATION

The original work at Silver Creek consisted of examinations of farm manure piles to determine the approximate number of feet of stalks on the surface of each pile and the approximate number of borers in the stalks. In order to attain a fair degree of accuracy in estimating the number of feet of exposed cornstalks on a manure pile, the number of feet of stalks on each of several piles was estimated by three persons. The stalks were then removed and accurately measured. This gave each observer an opportunity to learn whether he overestimated or underestimated the quantity of visible cornstalks per pile. In recording the observations the average of two or more such estimates was used, and in determining the number of borers in the stalks, a random sample consisting of 25 to 300 feet of stalks, depending usually upon the total quantity of visible stalks on the pile, was dissected, and the total borer population was estimated on the basis of the number found in the dissected portion.

The method employed by Mr. Schlosberg in examining manure piles in the Toledo area was essentially the same as that used at Silver Creek, except that approximately 200 linear feet of cornstalks was dissected from each manure pile examined. These examinations provided sufficient information concerning the number of borers on the surface of manure piles but afforded no knowledge of the abundance and fate of individuals which might be below the surface. Neither did they furnish information concerning the original larval population of the stalks.

The preliminary examinations in manure piles generally indicated that large numbers of larvae might winter over on the surface of the piles and become an important source of reinfestation in corn grown the following year. Farmers were advised to spread manure and plow it under cleanly before the emergence of corn borer moths, and to make every effort to collect all plant debris in barnyards and burn it

¹ The work in the Toledo area was conducted under the supervision of Morris Schlosberg, assistant entomologist, Bureau of Entomology.

or plow it under. At the same time a series of experiments was started at Silver Creek to determine the percentage of larvae which survived in manure piles, both when the infested material was completely buried in manure and when the material was mixed with manure in such a way as to simulate a common farm manure pile. In conducting this work a known number of larvae were put in each pile, and the piles surrounded by the regulation oilcloth recovery traps described in a previous publication.² The traps were examined at regular intervals, and all larvae found therein were removed and destroyed. A short time prior to the date on which emergence was expected, the piles were dismantled and all stalks, straw, and other litter examined for the presence of larvae and pupae, records being kept of the individuals found. The examinations were extremely

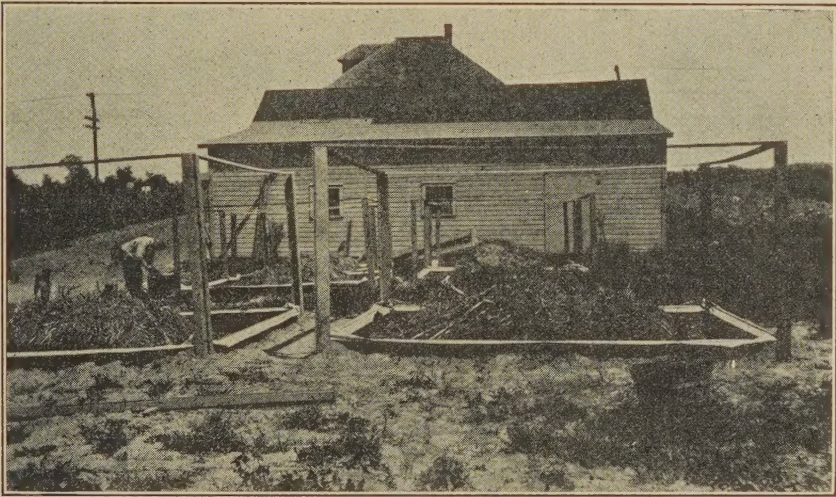


FIGURE 1.—Specially constructed manure piles showing oilcloth traps and frames, the latter to be covered with cheesecloth shortly before the emergence of corn borer moths. The infested stalks are completely buried in the left-hand pile and partially buried in the pile on the right

thorough, and many dead and living individuals were recovered. This procedure, however, involved considerable labor, and even though the examinations were carefully made there was no assurance that all larvae and pupae were recovered. Similar piles constructed in later years were completely screened with cheesecloth shortly before adult emergence was expected (fig. 1), and recoveries made in the form of moths rather than larvae. This method lessened the labor involved and assured the recovery of all surviving individuals in the experiment.

The farm manure piles, as well as the specially constructed manure piles in which observations were made, contained rather large quantities of plant remnants, and the results as hereinafter reported should not be confused with results obtained from observations made in piles of manure in a heating condition containing very small quantities of crop remnants. The farm manure piles where the Toledo observations were made were so situated that farm animals were allowed free access to them, although the manure was not trampled by animals to

² WORTHLEY, L. H., and CAFFEY, D. J. SCOUTING, QUARANTINE AND CONTROL FOR THE EUROPEAN CORN BORER, 1917-1926. U. S. Dept. Agr. Tech. Bul. 53, 142 p., illus. 1927.

the extent that it is trampled in an inclosed feed lot. It is quite probable, however, that many larvae were crushed or eaten by the animals.

The early experiments conducted at Silver Creek and Toledo furnished definite information concerning the survival of borers in the average farm manure pile, but this information could not be applied to feed lots in which cattle and other animals were allowed to run and trample corn remnants into the manure. During the winter and spring of 1928 and 1929, 40 head of cattle and 35 hogs were kept in a feed lot 60 by 80 feet at the experimental farm at Toledo, Ohio. In addition to other feed, these animals received the cornstalks from 31 acres, which contained approximately 188,000 corn borer larvae.



FIGURE 2.—Farm manure pile containing approximately 12,000 linear feet of infested cornstalks. The estimated larval population of the exposed stalks was 3,120

The feed lot remained wet during the entire period and was subjected to continual trampling by the animals.

OBSERVATIONS IN FARM MANURE PILES AT SILVER CREEK, N. Y.

EXAMINATIONS IN 1927

The piles of manure examined in 1927 contained more loose cornstalks (fig. 2) than those in which observations were made during the following two years. The smaller quantities of plant debris found in 1928 and 1929 were, apparently, a direct result of the recommendation made to farmers by various agricultural agencies that all plant remnants be removed from barnyards and buried or burned.

Table 1 records the results of observations made in the vicinity of Silver Creek, N. Y., in typical farm manure piles during the spring of 1927. No information was available regarding the original larval population of the stalks in the various piles, and it is probable that

those piles which produced few or no larvae contained stalks which were originally very lightly infested. The eight piles in which examinations were made contained approximately 68,100 linear feet of exposed cornstalks, and on the basis of the samples of stalks which were dissected from each pile, the larval population in the exposed stalks of the eight piles was approximately 13,500 individuals. It is quite possible that there were many living larvae in buried stalks, although no examinations were made below the surface of the piles. The results of these examinations showed conclusively that the farm manure pile in its usual form is a serious source of corn borer reinfestation.

TABLE 1.—*Record of examinations of farm manure piles for larvae of the European corn borer, Silver Creek, N. Y., 1927*

Pile No.	Date of observation	Estimated exposed stalks	Stalks examined	Larvae found	Total estimated larvae in exposed stalks
		<i>Feet</i>	<i>Feet</i>	<i>Number</i>	<i>Number</i>
1.....	May 18	50,000	65	12	9,230
2.....	do.....	12,000	100	26	3,120
3.....	May 20	500	50	2	20
4.....	May 17	2,000	125	0	0
5.....	do.....	300	75	1	4
6.....	do.....	1,000	90	17	189
7.....	do.....	300	35	1	9
8.....	do.....	2,000	65	30	923
Total.....		68,100	605	89	13,495

EXAMINATIONS IN 1928

In 1928 additional observations of farm manure piles were conducted at the Silver Creek, N. Y., laboratory, and similar work was begun in Toledo, Ohio. In Table 2 are recorded the results of the observations made during 1928 at Silver Creek, N. Y. As the result of clean-up regulations and recommendations made by various State and Federal agencies the quantity of visible corn remnants in manure piles examined in the Silver Creek district in 1928 showed a decided decrease. The number of larvae found in manure piles also decreased decidedly—undoubtedly a result of the clean-up campaign conducted during the season of 1927, which diminished by 18 per cent the stalk infestation in the area in which the observations of manure piles were made. Despite the decreased quantity of visible plant debris, however, the results still showed conclusively that the average farm manure pile in the most heavily infested district contains corn borer larvae in sufficient numbers to become a dangerous source of reinfestation.

TABLE 2.—*Record of examinations of farm manure piles for larvae of the European corn borer, Silver Creek, N. Y., 1928*

Pile No.	Date of observation	Estimated exposed stalks	Estimated living larvae in exposed stalks	Estimated dead larvae in exposed stalks	Pile No.	Date of observation	Estimated exposed stalks	Estimated living larvae in exposed stalks	Estimated dead larvae in exposed stalks
		<i>Feet</i>	<i>Number</i>	<i>Number</i>			<i>Feet</i>	<i>Number</i>	<i>Number</i>
1.....	May 17	15,000	465	855	10.....	May 7	350	24	7
2.....	May 14	2,000	120	20	11.....	do	50	16	0
3.....	do	350	0	0	12.....	do	250	25	15
4.....	May 12	3,500	49	7	13.....	May 1	500	30	10
5.....	May 13	350	7	14	14.....	do	2,000	60	60
6.....	May 11	1,200	56	7	15.....	May 18	75	0	4
7.....	May 10	300	0	0					
8.....	May 9	1,000	20	40	Total.....				
9.....	May 8	200	0	0			27,125	872	1,039

EXAMINATIONS IN 1929

The observations in farm manure piles were continued in 1929 at both Toledo and Silver Creek, and results similar to those secured in previous years were obtained. Sixteen piles containing an estimated total of 15,500 linear feet of exposed cornstalks were examined in the Silver Creek district. On the basis of dissected portions selected from each pile it was estimated that the piles contained a total surface population of 3,300 corn borer larvae. As in former investigations of this kind no examinations were made below the surface.

OBSERVATIONS IN FARM MANURE PILES AT TOLEDO, OHIO

EXAMINATIONS IN 1928

The results of observations made in manure piles at Toledo, Ohio, during the season of 1928, confirmed those obtained at Silver Creek, although the average manure pile in the Toledo district contained a smaller number of living larvae than a similar pile in western New York. Twenty-five piles examined near Toledo produced a total of approximately 780 living larvae, or 31 larvae per pile, and approximately 37,100 feet of debris, or 1,484 feet per pile. This information was obtained from studies of samples of stalks from each pile. No information was available concerning the original larval population of the stalks, but it is probable that they contained fewer larvae than those thrown in manure piles at Silver Creek. The fact that the manure piles observed in the Toledo district were usually located in barnyards where animals were allowed to feed may explain, in part, the comparatively small number of larvae found in many piles. Although the manure in these piles was not trampled as it is in a fenced feed lot, cattle and hogs were allowed free access to them, and it is probable that rather large numbers of larvae were destroyed by the animals.

EXAMINATIONS IN 1929

The 1929 observations about Toledo were made in 21 manure piles containing an approximate total of 107,100 linear feet of cornstalks, or 5,100 feet per pile. The surface population of the 21 piles was approximately 15,800 larvae, or 752 larvae per pile. As previously stated, the manure piles which were examined in the vicinity of Toledo

were located in barnyards, and farm animals were allowed to walk over and around them. The manure was not trampled as it is in a feed lot, but it is quite probable that many larvae were killed by the animals. No animals, except chickens, were allowed free access to the piles examined at Silver Creek.

No new information was obtained from the observations of 1929 in farm manure piles, but the results of previous examinations were verified, and it was apparent that large numbers of larvae may winter over in such locations.

OBSERVATIONS IN SPECIALLY CONSTRUCTED MANURE PILES AT SILVER CREEK, N. Y.

EXPERIMENTS IN 1927

In order to check the results to be obtained from the observations in 1927 in farm manure piles, a pile of barnyard manure containing a rather accurately determined number of larvae had been constructed in December, 1926, and surrounded by an oilcloth trap to stop all migrating larvae. The infested cornstalks which were used in constructing the pile contained approximately 500 living larvae, and the stalks were completely buried in manure to a depth of at least 6 inches. In estimating the number of larvae placed in the pile a sample consisting of 100 stalks was carefully dissected in order to learn the average number of living larvae per stalk. The number of stalks required to furnish 500 larvae was based upon this figure. Occasional observations of the trap were made during the winter, but no larvae were found in it until April 8, 1927, when 20 were recovered. In inspections of the trap made at regular intervals during the period from April 8 to June 23, 287 larvae were observed, or about 57 per cent of the estimated original population of the pile. On June 23 the pile was dismantled, and all plant remnants which might harbor corn borer larvae were carefully dissected. A total of 129 living and dead individuals were recovered from the dissected material—97 from straw on the surface of the pile and 32 from below the surface. Of the 97 individuals recovered from the surface of the pile, 3 were dead, whereas 26 dead larvae were recovered from the buried stalks.

It is probable that infested cornstalks could be buried deeply enough in manure to prevent the migration of larvae to the surface, but this would not be a practical farm operation, and for that reason the minimum depth of 6 inches was used in all piles containing completely buried stalks. The results obtained in this experiment indicated that corn borer larvae, even though they are completely buried by at least 6 inches of manure, may migrate to the surface in large numbers and cause infestation in the following year's corn crop. The manure used in constructing the experimental pile contained considerable straw, and the heat developed in the pile was not so great as in one constructed of manure containing little or no plant debris.

EXPERIMENTS IN 1928

The first experimental manure pile, constructed at Silver Creek in December, 1926, contained infested stalks completely buried to a depth of at least 6 inches. In December of the following year a similar pile with completely buried stalks was built; and in addition, another pile containing about 500 larvae in cornstalks was constructed, the

stalks instead of being all completely buried being mixed with the manure in such a way as to resemble, as nearly as possible, conditions found in an average farm manure pile. These two piles were handled in the same way as the pile constructed the previous season except that screen cages were constructed over them shortly before adult emergence of 1928 was expected (fig. 3) instead of the pile being searched for living or dead larvae. All adults were collected in the cages at regular intervals and removed.

The numbers of larvae and adults recovered in the oilcloth traps and in the screen cages are shown in Table 3. No dead were found in this case.

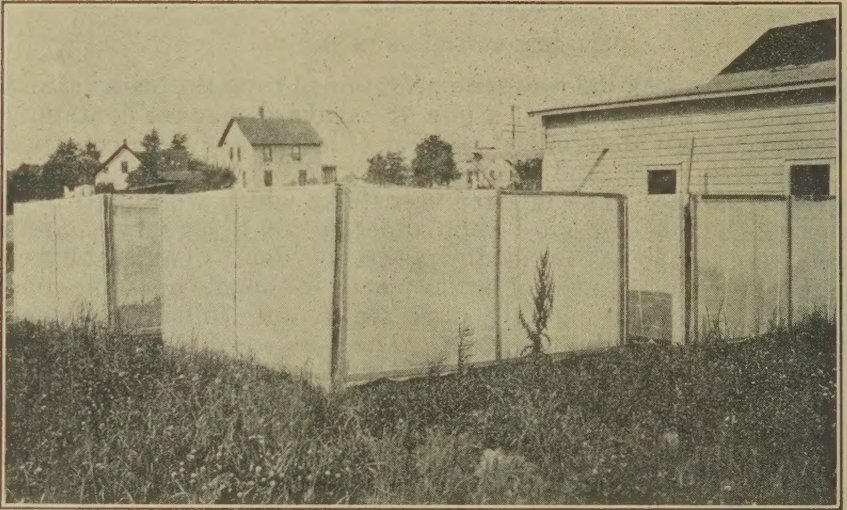


FIGURE 3.—Cheesecloth cages surrounding specially constructed manure piles. Corn borer adults were collected in the cages as they emerged

TABLE 3.—*Recoveries of larvae and adults of the European corn borer from specially constructed manure piles, Silver Creek, N. Y., 1928*

Date of observation	Numbers of larvae recovered in traps from—		Date of observation	Numbers of adults recovered in screened cages	
	Pile No. 1 (stalks buried)	Pile No. 2 (stalks partly buried)		Pile No. 1 (stalks buried)	Pile No. 2 (stalks partly buried)
May 8.....	17	1	July 11.....	81	8
May 15.....	13	1	July 16.....	45	9
May 21.....	10	2	July 21.....	43	8
May 28.....	0	0	July 25.....	7	2
June 8.....	10	1	July 28.....	0	1
June 21.....	3	3	Total.....	176	28
June 30.....	2	0	Total larvae and adults..	231	36
Total.....	55	8			

More than six times as many individuals were recovered from the pile containing completely buried stalks as from the one containing stalks only partially buried. The adults emerging in the cages appeared to be normal in all respects, and several of them produced fertile eggs under cage conditions.

As there are usually numerous places of refuge for the emerging larvae in the vicinity of manure piles, it is obvious that the burying of infested material in them can not be considered favorably as a method of control. The conditions met by the emerging larvae are quite different from those prevailing in a cleanly plowed field in that they are favorable to the survival of the borers.

[CHECK EXPERIMENTS IN 1928-29]

It was apparent that the treatment of infested material by placing it in farm manure piles could not be recommended. In order to confirm definitely the results obtained in 1927 and 1928, however, several more piles, comprising three series, were constructed at Silver Creek, N. Y., in the winter of 1928-29. In conducting the experiments of 1927 and 1928 at Silver Creek, involving the use of specially constructed manure piles, little consideration had been given to the dates on which the piles were prepared. The original pile, that for the 1927 experiment, was constructed on December 23, 1926, and on December 13, 1927, the second, or 1928, experiment was begun. The experiment conducted in the fall of 1928 and spring of 1929 consisted of three series—one series constructed on November 15, 1928, a second on December 10, 1928, and a third on March 28, 1929. Each series was composed of two piles, each containing approximately 500 larvae in cornstalks. One pile in each series contained infested cornstalks completely buried to a depth of at least 6 inches and the other was made as near like a farm manure pile as possible. Oilcloth traps and screened cages were used as in the 1928 experiment. The results are given in Table 4.

TABLE 4.—*European corn borer recoveries from specially constructed manure piles, Silver Creek, N. Y., 1929*

NUMBERS OF LARVAE RECOVERED IN TRAPS

Date	Series No. 1, started Nov. 15, 1928		Series No. 2, started Dec. 10, 1928		Series No. 3, started Mar. 28, 1929	
	Pile No. 1 (buried)	Pile No. 2 (partly buried)	Pile No. 1 (buried)	Pile No. 2 (partly buried)	Pile No. 1 (buried)	Pile No. 2 (partly buried)
1928						
Dec. 3.....	6	0	-----	-----	-----	-----
Dec. 7.....	4	0	-----	-----	-----	-----
Dec. 12.....	0	0	0	0	-----	-----
Dec. 28.....	4	0	0	0	-----	-----
1929						
Jan. 18.....	10	0	0	0	-----	-----
Mar. 13.....	5	1	0	0	-----	-----
Mar. 26.....	0	0	3	0	-----	-----
Apr. 4.....	8	1	13	1	5	4
Apr. 10.....	13	1	7	1	25	4
Apr. 16.....	4	1	1	0	2	3
Apr. 22.....	2	1	0	1	6	2
Apr. 26.....	13	13	5	2	20	9
Apr. 30.....	4	0	0	3	2	4
May 4.....	0	0	0	0	5	3
May 8.....	1	1	1	1	1	1
May 11.....	0	2	0	0	1	0
May 15.....	0	1	2	0	4	0
May 18.....	0	1	0	0	2	2
May 22.....	0	1	0	0	3	0
May 25.....	0	0	1	0	1	1
May 29.....	2	2	1	0	3	2
June 3.....	0	2	0	1	3	3

TABLE 4.—*European corn borer recoveries from specially constructed manure piles, Silver Creek, N. Y., 1929—Continued*NUMBERS OF ADULTS¹ RECOVERED IN SCREENED CAGES

Date	Series No. 1, started Nov. 15, 1928		Series No. 2, started Dec. 10, 1928		Series No. 3, started Mar. 28, 1929	
	Pile No. 1 (buried)	Pile No. 2 (partly buried)	Pile No. 1 (buried)	Pile No. 2 (partly buried)	Pile No. 1 (buried)	Pile No. 2 (partly buried)
1929						
June 22.....	4	2	9	2	7	13
June 25.....	7	3	12	3	20	8
June 28.....	4	1	9	1	3	9
July 1.....	12	15	33	8	36	45
July 3.....	0	6	4	9	4	4
July 5.....	19	10	10	18	33	17
July 8.....	9	16	5	27	33	41
July 10.....	11	24	5	15	26	27
July 12.....	4	7	1	18	16	27
July 15.....	7	4	2	16	10	18
July 17.....	1	7	0	9	5	10
July 19.....	0	3	0	2	0	2
July 22.....	0	2	0	0	6	3
July 24.....	0	0	0	1	0	0
July 26.....	2	0	0	0	3	2
July 29.....	1	0	0	0	1	0
Total larvae and adults recovered...	157	128	124	139	286	264
Approximate percentage of original larvae recovered.....	31	26	25	28	57	53

¹ Approximately one-half of the adults recovered were females.

Although some variation was noted in the number of individuals recovered in the three series, the recoveries from all piles were large enough to show that placing infested material in typical farm manure piles is not a satisfactory means of corn borer control. Referring to Table 4, it may be seen that the survival in the fall-constructed piles was noticeably smaller than in the series constructed in the spring. The most promising results were obtained from the series constructed in December, 1928, but even in this series more than 25 per cent of the larvae were recovered in the traps and cages. The difference in survival in the manure piles prepared by the two methods was not so noticeable as in a previous experiment (Table 3.) Although in Series 1 and 3 of Table 4 the survival was somewhat less in partially buried material than in completely buried material, in Series 2 it was slightly greater.

THE DISTANCE TRAVELED BY LARVAE MIGRATING FROM MANURE PILES

In conducting the experiments involving specially constructed manure piles many larvae were recovered in the traps surrounding the piles, and it was evident that an investigation should be made of the distance which these migrating larvae would have traveled had no barrier been constructed to stop them. In order to obtain this information, a manure pile was constructed on April 10, 1929, containing about 500 larvae in cornstalks buried to a depth of at least 6 inches. A trap was placed around the pile at a distance of 10 feet, and daily observations of the trap were made to determine the presence of migrating larvae. As soon as one or more larvae were found

the trap was taken up and moved back an additional 5 feet from the pile, the object of the experiment being to determine the distance traveled by migrating larvae rather than the number of larvae which left the pile. On May 18, two larvae were recovered at a distance of 25 feet from the pile, and the trap was moved back an additional 5 feet, where it remained until July 10. No recoveries were made at a distance of 30 feet. The results of this experiment are recorded in Table 5.

TABLE 5.—*Record of distances larvae migrated from a manure pile, Silver Creek, N. Y., 1929*

Date of recovery	Distance from pile	Larvae recovered
	Feet	Number
Apr. 26.....	10	2
May 8.....	15	1
May 15.....	20	3
May 18.....	25	2

OBSERVATIONS IN FEED LOTS AT TOLEDO, OHIO, IN 1929

Investigations of the effectiveness of the trampling of infested material by farm animals as a corn borer control measure were conducted in a feed lot at Toledo, Ohio, during the winter and spring of 1928 and 1929. Conditions prevailing in the feed lot during the experiment were similar to those found in the average feed lot in the vicinity, and it was necessary to introduce no artificial factors. The feed lot was 60 by 80 feet, and 40 head of cattle were kept in it during the winter and spring. In addition to the cattle, 35 hogs were fed and quartered in the inclosure. The cornstalks from 31 acres of land, containing roughly 188,000 corn borer larvae, were fed to the cattle and hogs, the uneaten portions being trampled into the manure by the animals.

A short time prior to the period of moth flight approximately one-sixth of the area, or 784 square feet, was inclosed in a screen cage in order to confine emerging adults. Assuming that there was an even distribution of corn remnants over the entire feed lot, the screened portion, 28 by 28 feet, had contained approximately 30,600 borers. Of this number, 49 adults (24 males and 25 females) were recovered, representing an adult survival of 0.16 per cent of the original borer population, or an effective disposal of 99.84 per cent of the original borer population of the stalks in the feed lot.

Cornstalks and other plant remnants had accumulated at the base of the wood fence which surrounded the feed lot, and this material acted as an effective trap for migrating larvae. Approximately one-sixth of the fence was included in the screen cage. The land on the outer side of the fence was kept free from material which might have offered protection to migrating larvae, and it is very improbable that any larvae migrated beyond the fence and escaped. It is apparent that the unfavorable conditions of moisture and temperature in feed lots similar to the one described above, supplemented by the trampling of animals, result in the destruction of practically all

corn borer larvae and that this measure can be safely recommended as a means of treating infested material. On the other hand, feed lots which are not sufficiently trampled are a source of infestation. (Fig. 4.)

SUMMARY AND CONCLUSIONS

The fact that conditions existing in silos resulted in the destruction of all corn borer larvae put therein led to the suggestion that similar results might be obtained by mixing infested material with manure. This would have been a very simple means of disposal, and, with the possible exception of removing plant remnants from the surface of piles, it would have involved no extra labor on the part of the farmer. Preliminary experiments, however, indicated that the number of larvae escaping from farm manure piles would prohibit the use of such piles as a control measure.

Investigations in connection with the survival of larvae of the European corn borer in manure piles and feed lots were conducted at Toledo, Ohio, and Silver Creek, N. Y., over the 3-year period 1927 to



FIGURE 4.—A feed lot which was not sufficiently trampled by animals. Approximately 15,000 exposed stalks were estimated to contain some 39,000 larvae. (Photo by H. N. Bartley)

1929, inclusive. At Silver Creek, the observations involved manure piles of various kinds, whereas both farm manure piles and feed lots were included in the examinations at Toledo. The study of manure piles on farms was limited to surface observations, and it was necessary, in order to obtain information concerning the interior of such piles, to construct manure piles containing rather accurately determined numbers of larvae and to ascertain the total number of larvae surviving in each pile. Each of these specially prepared manure piles was surrounded by a trap which confined all migrating larvae, and in 1928 and 1929 the piles were covered with screened cages which assured the recovery of all adults as they emerged.

It was finally demonstrated that corn borer larvae migrate in large numbers from farm manure piles; that these larvae may migrate to a distance of 25 feet, and that the adults resulting from such larvae are

fertile and capable of infesting the next crop of corn. It is therefore strongly recommended that farmers avoid placing infested material in manure piles, that all manure from piles containing infested material be cleanly plowed under early in the spring before larvae begin to migrate in large numbers, and that plant remnants be removed from barnyards and destroyed or buried.

In conducting the work at Toledo on the survival of larvae in feed lots, an inclosure 60 by 80 feet was used, in which 40 head of cattle and 35 hogs were fed. Observations made in the feed lot in the spring of 1929 indicated that practically all of the larvae had been destroyed.

It appears that the number of larvae surviving in feed lots is so small that infested material may be placed in such feed lots and be left there with no treatment in addition to being trampled by animals. It is essential, however, that the trampling be thoroughly done and that no dry or unbroken sections of cornstalks be left on the surface of the feed lot. When all plant remnants are thoroughly mixed with manure by means of trampling, no other treatment need be given, and this control method is recommended as a means of disposing of infested material. There is no evidence to indicate that the time of trampling is an important factor, except that the trampling should be completed before the emergence of moths, which does not occur in this area before June 1. If it is found that the infested stalks have been insufficiently trampled and that they still contain living larvae, it is recommended that such material be completely plowed under before May 15.

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